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(54) Abstract Title
Controlling a pressure regulating system with an underground module

(57) A system for regulating the gas pressure in a gas supply includes an underground pressure regulating module cartridge 112 for insertion into an underground chamber. This receives a high pressure gas stream and produces a low pressure output at a regulated pressure. The cartridge includes a main regulator valve 118 with associated pilot valves 120, 168, and a slam shut valve. Data relating to gas utilisation and pressure variation is obtained over a predetermined period of time (figure 3) by a logging device. From this information, a plurality of setting parameters are determined which replicate the utilisation requirements over a given time period; for instance, the variations in demand at different times throughout the day and night. Control means 153 then controls the pilot valve 168, and thus the main regulator valve 118, in accordance with the gas requirements determined for the current time period. The pilot valve 168 can include a double diaphragm. The predetermined utilisation data and control data can be received by the control means from a remote site via a modem.

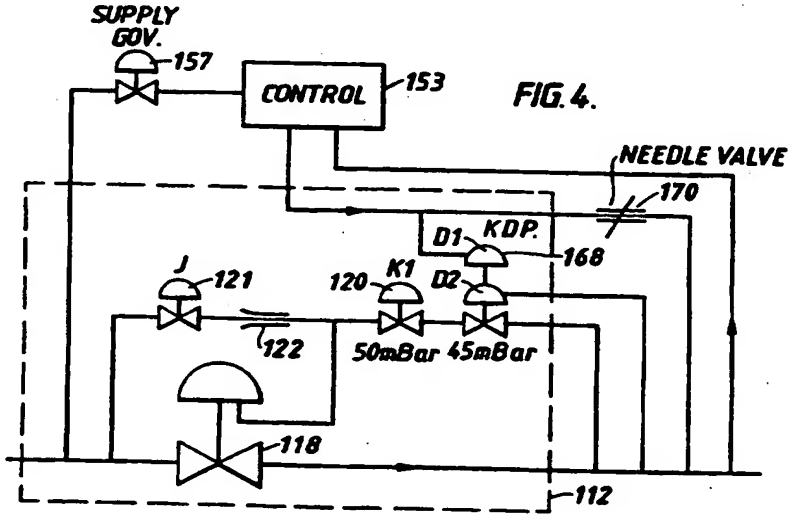

FIG. 4.

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FIG. 1.

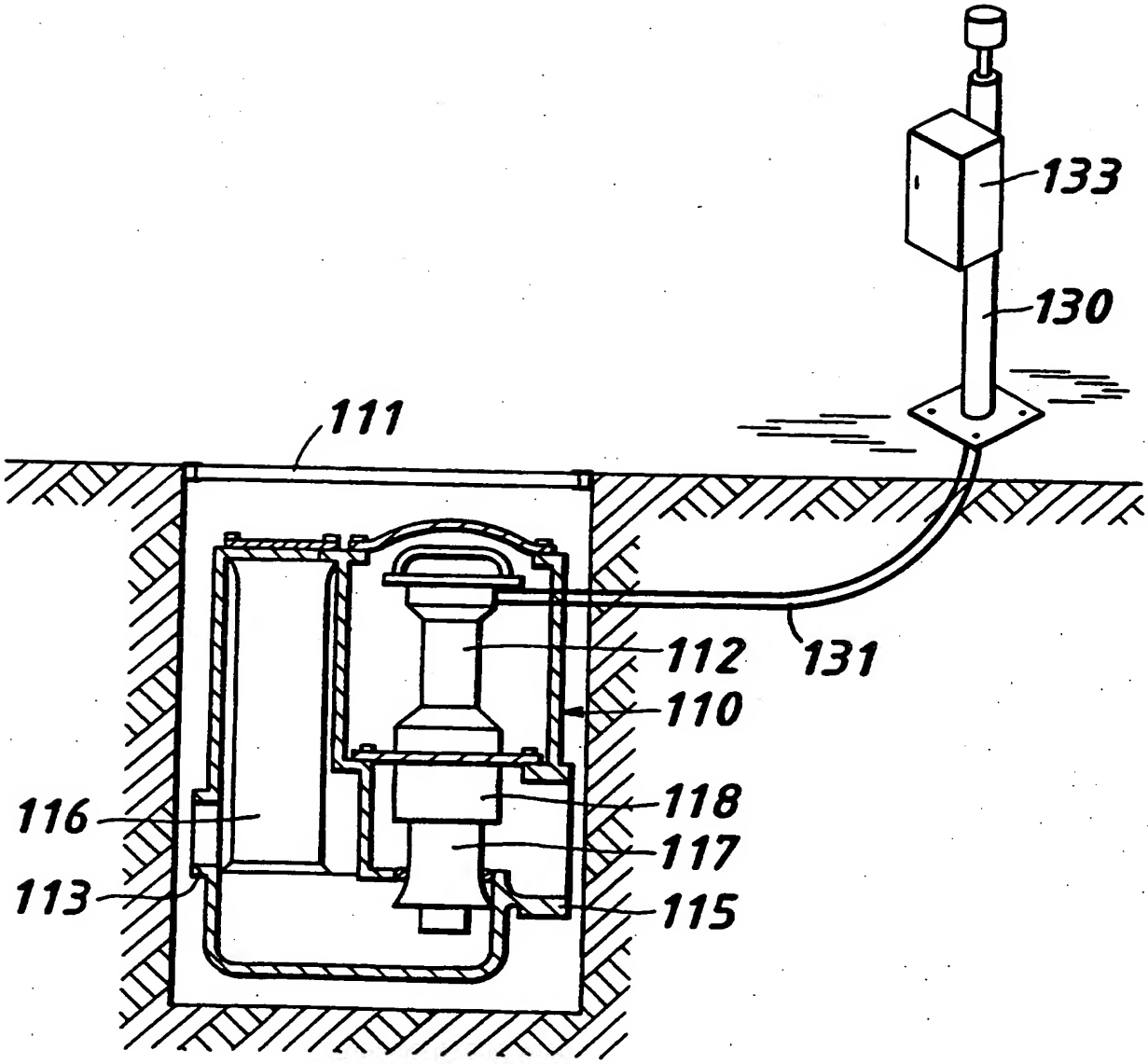

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FIG.2.

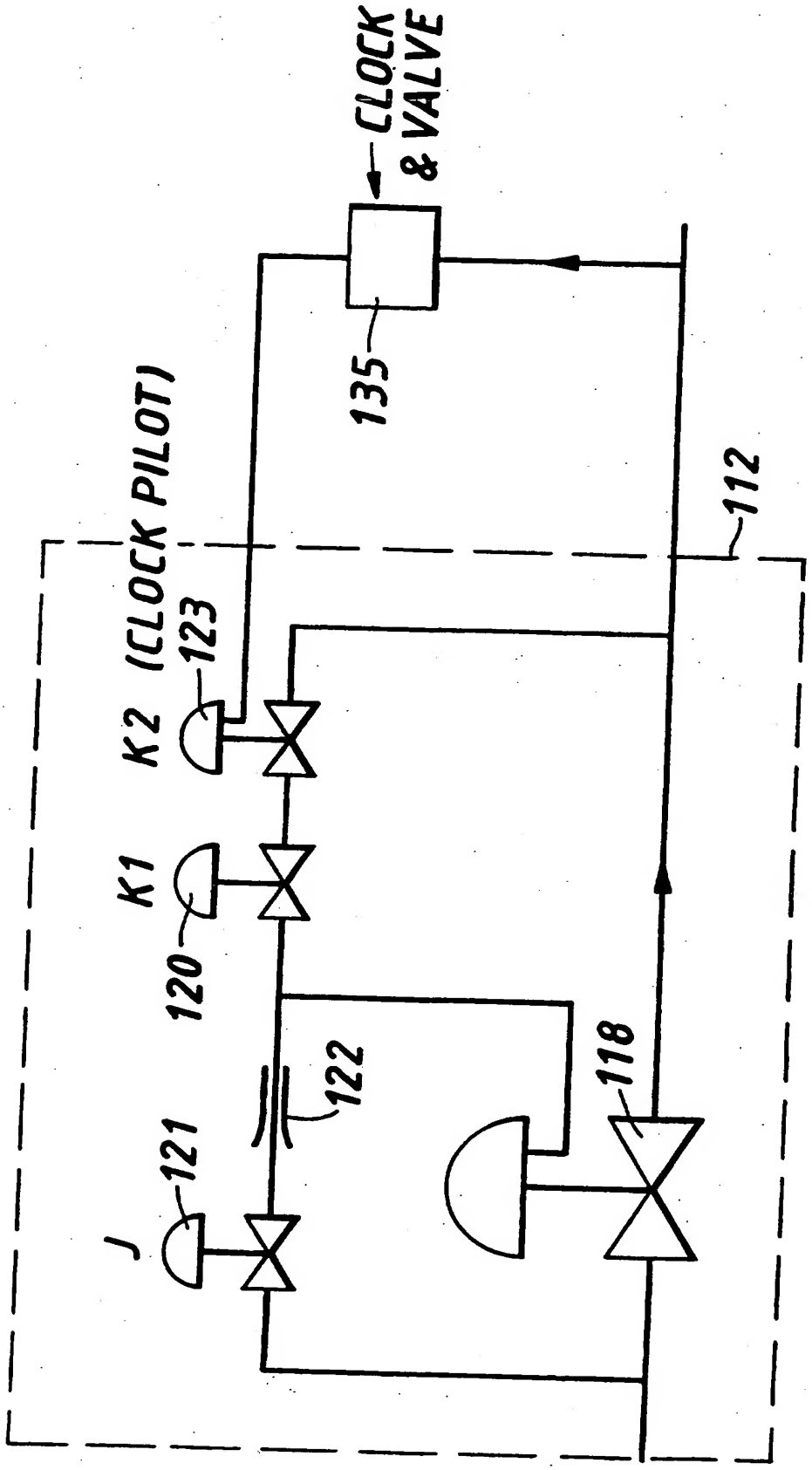

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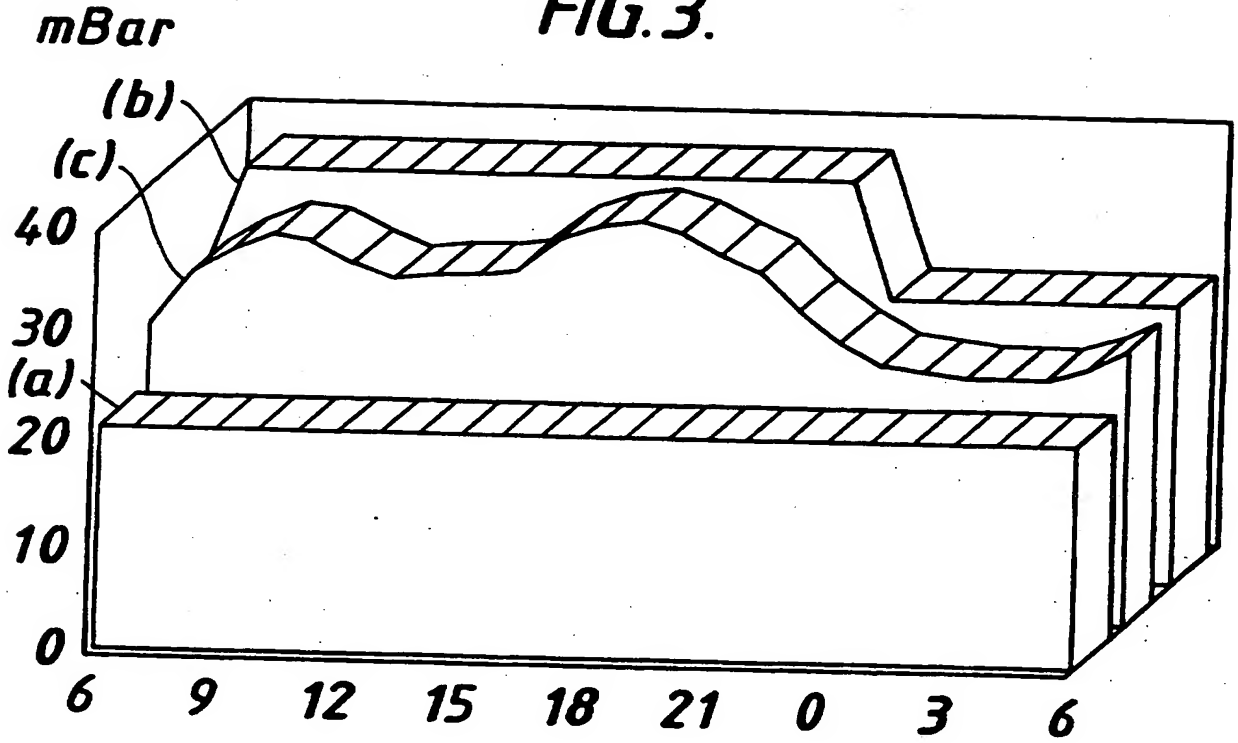
FIG. 3.



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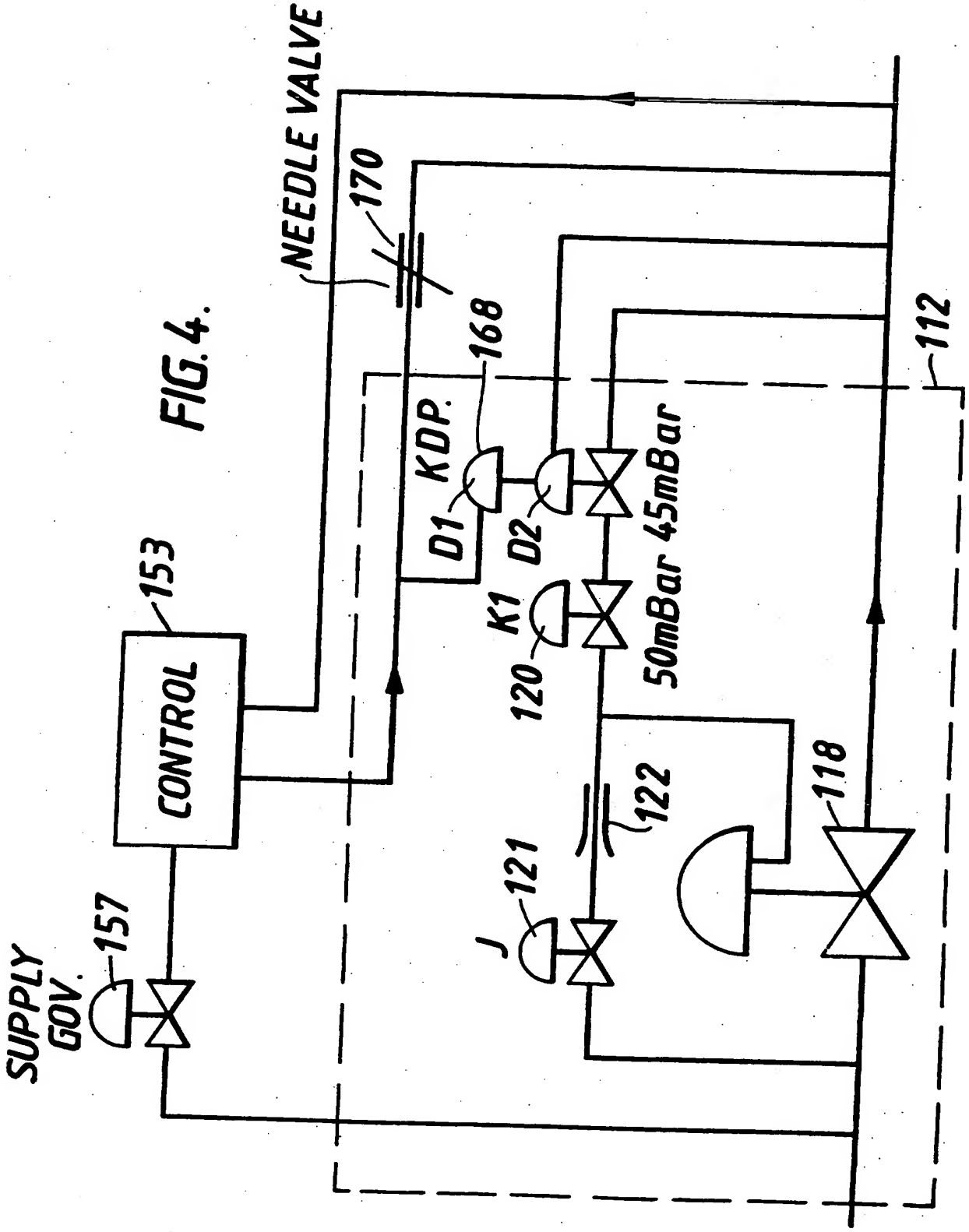

FIG. 4.

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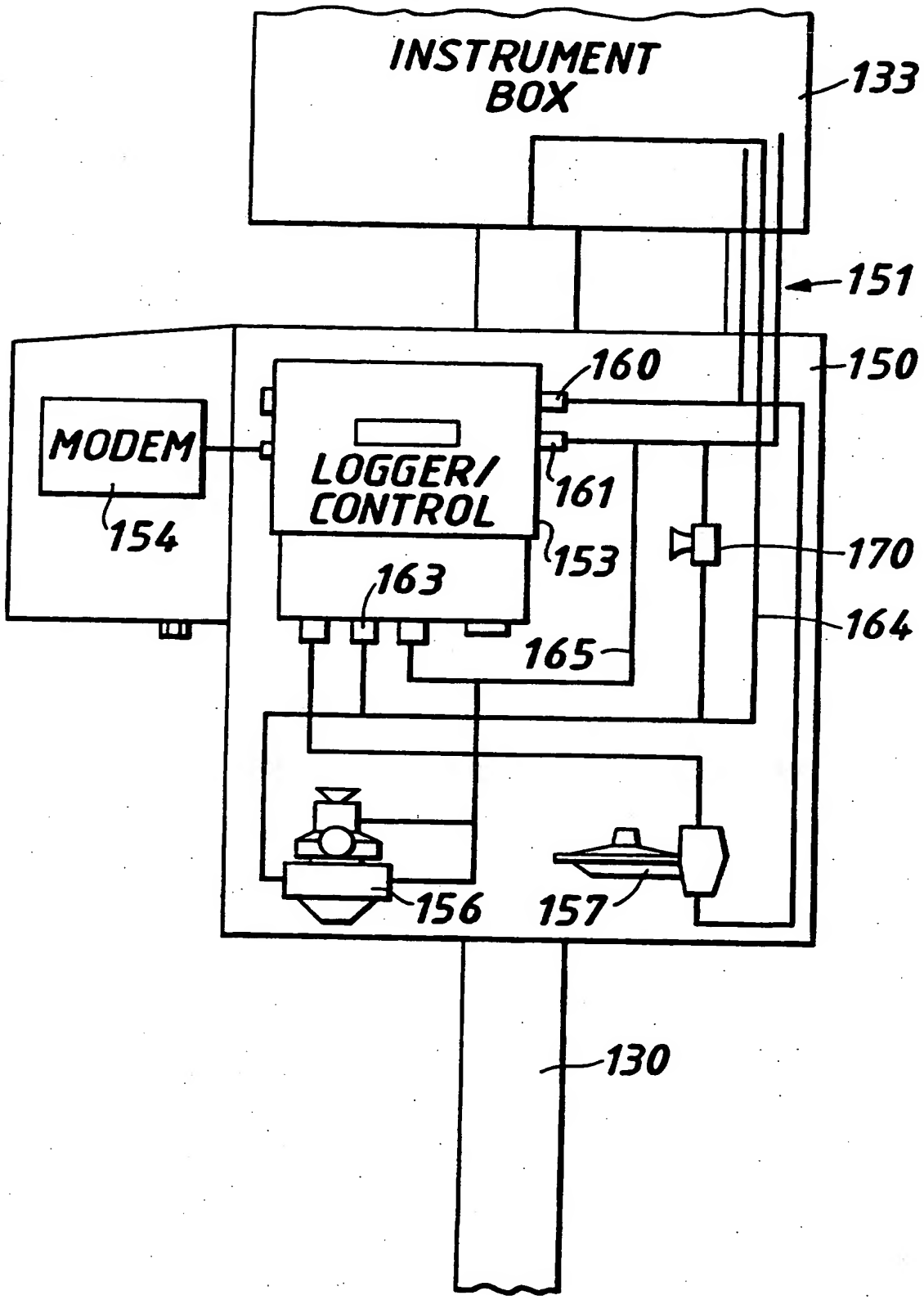
FIG. 5.



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PRESSURE REGULATING SYSTEM

The invention relates to a Pressure Regulating system using an underground fluid pressure regulating control module (e.g. for fuel gas) within a pipeline.

In known underground systems a complete gas pressure regulator module 110 is provided (see Figure 1) within an underground chamber with all the major control devices being incorporated within the module housing and the module can easily be replaced for maintenance and other purposes. There is access to the module via manhole cover 111. In practice the buried system pipeline will typically include an inlet valve, an outlet valve an a flap type non return valve outside the module.

An inlet has a flange 113 (e.g. 150 mm) for coupling to an inlet pipe and a flange 115 (e.g. 200 mm) for coupling to an outlet pipe.

The underground module includes a filter 116 through which the gas passes into the chamber and hence to the removable cartridge 112. A slam-shut valve 117 is connected in series with the pressure regulator valve 118. A number of additional components are provided including several pilot valves. The cartridge is pre-assembled and easily replaceable to reduce downtime.

Such a regulator control module can typically cope with inlet pressures up to 4 Bar and outlet pressure set to between 20 and 75 mBar with a flow capacity of up to 8,500 m^3/Hr. A vent stack 130 provides a reference atmospheric pressure point for the cartridge 112 and houses other lines (shown schematically as pipe 131). The

instrument box 133 contains a chart recorder for inlet and outlet pressures and various test points (e.g. for slam-shut testing).

In order to increase the operational efficiency of the pipeline system it is possible to include a clock operated actuator to allow a different set pressure to be available when demand is low throughout the night.

Such an arrangement is shown in Figure 2 with the slam-shut valve 117 having been omitted for the sake of clarity. The flow pressure is controlled by the main regulator valve 118 and the set point of the valve 118 is provided by pilot valve 120 (K1). The pilot control operates by receiving a pre-regulated supply of gas via the regulator 121 (J) before passing through a restrictor pipe 122 and then through the pilot regulator 120 (K1) before being bled to the outlet main (ignoring optional pilot regulator 123 (K2) for the moment). The main regulator valve 118 receives gas to its control line adjacent the outlet of the restrictor 122. Any pressure changes sensed by the pilot as it operates resulting in velocity changes in the restrictor causing a venturi effect which results in gas being sucked back from the line from the main regulator valve 118. This causes the pressure applied countering the spring regulating the diaphragm in the regulator 118 to change to bring the output pressure back in line with the preset value set by pilot 120.

Where a clock is employed, the additional pilot 123 (K2) is provided with a different set point to deal with a different set demand level such as during the night. This will require a clock device 135 with associated valve which is connected to the pilot 123 via a fluid line.

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The objection of the present invention is to provide a modified arrangement with a more sophisticated control to reflect demand more closely yet be incorporated largely within the underground module.

According to the invention there is provided a fluid pressure regulating system including a removable underground regulator module for insertion into an underground chamber in use, said removable cartridge including a main pressure regulator valve and a slam shut safety valve connected in series with the regulator, and control means for providing a plurality of setting parameters during a predetermined period to replicate utilisation requirements and means within the module for responding to said parameters to effect changes in the operation of the main regulator valve within the module to provide a variable desired output pressure to meet utilisation requirements.

Further according to the invention there is provided a method of regulating pressure in a fluid regulating system including a removable underground regulation module cartridge having a regulator valve and slam shut valve therein, the method comprising: monitoring fluid utilisation over a given period in a logging device, providing a plurality of setting parameters during a preset period based on historic utilisation information and controlling the regulation valve within the cartridge by control means to vary the flow output in response to the setting parameters to effect changes to a desired output pressure to meet utilisation requirements.

The invention will now be described by way of example with reference to the accompanying drawings, in which:

Figure 1 shows an underground pressure regulating module;

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Figure 2 shows a mechanism for controlling output pressure with an incorporated clock mechanism;

Figure 3 shows a graph of utilisation and output pressure requirements over time;

Figure 4 shows a modified arrangement with variable pressure regulation; and

Figure 5 shows the logger/control arrangement in more detail.

Figure 3 shows pressure graphs for the gas supply. Hence the requirement is to supply customers with a stream of gas at a steady pressure of at least 20 mBar (see Graph (a)). In practice it is possible to reduce the available pressure at the regulator output from 40 mBar to say 30 mBar during the night using the clock arrangement described earlier (see Graph (b)) and still provide customer requirements.. The present invention allows a modified underground module to have a continuously variable pressure setting dependent on previously monitored utilisation at that particular station in the gas supply network. A utilisation profile (see Graph (c)) allows the output availability of (a) to be maintained to meet demand requirements whilst allowing reduced pressure to be selected, hence lowering volume requirements and the likelihood of leakage, etc. Although the variations of Graph C are shown as being relatively static over any given short period (e.g. one hour) in practice a large number of variations can be accommodated if desired.

In order to perform the function desired the module cartridge 112 is modified as shown in Figure 4.

The pilot valve 123 of Figure 2 has been replaced by a dual diaphragm valve 168 (K_{DP}) which receives control from a logger/controller 153. The other pilot 120 (K1) can be

retained if required for safety reasons. A supply governor 157 provides a regulated supply of gas to the control for its use. A needle valve 170 provides a restricted path setting which, should there be a failure of the controller 153, it will act as a fail safe to give a stable controlled output pressure at the predetermined set level.

In operation, the controller 153 is programmed with information to allow it to impulse the top diaphragm D1 of the valve 168 to cause a variable setting of this valve depended on the previously stored information to allow continuous pressure variation setting to meet the profile of Figure 3(c).

In practice, to house the controller, an additional box, control box 150 (see Figure 5), is mounted on vent stack 130 below the existing instrument box 133. Lines for operational control are fed through tube 151 from the instrument box 133. The heart of the control arrangement is the controller/logger 153 which can include a microprocessor, memory, clock and display. A modem 154 allows logged information to be received remotely and control information passed to the logger/control 153 from a remote site. Dependent on operational and safety requirements a low pressure slam-open valve 156 and supply pressure regulator 157 can be included.

The controller/logger monitors pressure/usage and so receives the gas supply through a small tube at inlet 160. It also uses the gas to operate components and receives this via the supply pressure regulator 157. The outlet 161 passes to the instrument box 133. A control output 163 provides pressure control to the underground regulator via flexible pipe 164 which is the control line also received by the slam-open valve 156. In the event of a fault, when the slam-open valve senses low output it will dump control

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pressure to the outlet and allow the outlet to rise to the underground regulator preset value. Line 165 provides a route to exhaust the gas during setting changes.

The logger/controller 153 monitors and records information on usage/pressure to allow a profile to be known for that station and this is typically downloaded once every 24 hours following a prompt signal via the telephone link to the modem 154. This information is utilised by a remote computer (not shown) to calculate expected usage requirement and selects a stream of different pressure settings for use throughout the next 24 hours (with a margin for handling a somewhat increased loading) and downloads this via the telephone line to the controller which uses its internal clock to increment and decrement the pressure as previously instructed throughout the day to provide variable pressure control to the cartridge 112 so as to produce the results shown in the Graph in Figure 2C for example.

The logger can also produce alarm and other signals for sending to the remote site via the modem. Although a telephone line can be used, radio or other transmission techniques could be utilised.

The cartridge is easily interchangeable with that of Figure 1 and needs no excavation work because it slides into the existing chamber and is closed using the same bulkhead.

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CLAIMS

1. A fluid pressure regulating system including a removable underground regulator module cartridge for insertion into an underground chamber in use, aid removable cartridge including a main pressure regulator valve and a slam shut safety valve connected in series with the regulator, and control means for providing a plurality of setting parameters during a predetermined period to replicate utilisation requirements and means within the module for responding to said parameters to effect changes in the operation of the main regulator valve within the module to provide a variable desired output pressure to meet utilisation requirements.

2. A system as claimed in claim 1, wherein the means to effect changes in the operation of the main regulator valve include a dual diaphragm mechanism providing differential control.

3. A system as claimed in claim 2, wherein the means is located on the module but separate from the main regulator valve.

4. A system as claimed in claim 1, 2 or 3, wherein logging means are provided for monitoring fluid utilisation over a given period to assist in determining future utilisation requirements.

5. A system as claimed in claim 4, wherein remote access means are provided to receive the logged information, means for computing the setting parameters

therefrom and means for transmitting the parameter information to allow control of the remote regulating system.

6. A system as claimed in claim 4 or 5, wherein the logging means is provided on a vent stack above ground level.

7. A system as claimed in any preceding claim, wherein a regulated pressure source is provided for the control means and a slam-open valve is provided to open in the event of a fault condition developing.

8. A system as claimed in any preceding claim, including needle valve means to provide a stable reference setting in the event of failure of the control means.

9. A method of regulating pressure in a fluid regulating system including a removable underground regulation module cartridge having a regulator valve and slam shut valve therein, the method comprising: monitoring fluid utilisation over a given period in a logging device, providing a plurality of setting parameters during a preset period based on historic utilisation information and controlling the regulation valve within the cartridge by control means to vary the flow output in response to the setting parameters to effect changes to a desired output pressure to meet utilisation requirements.

10. A method as claimed in claim 9 including remotely accessing the logged information, computing the setting parameters therefrom and transmitting the parameter settings back to the regulator system to allow control thereof.

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11. A method as claimed in claim 9 or 10 including controlling a dual diaphragm control valve to modulate the setting of the regulator valve.

12. A method as claim in claim 9,10 or 11 including opening a slam open valve in the event of a fault to allow pressure to rise to a preset value.

13. A method as claimed in any one of claims 9 to 12, including providing a needle valve to facilitate a stable reference in the even of control means failure.

14. A fluid pressure regulating system substantially as described herein with reference to Figures 3 to 5 of the accompanying drawings.

15. A method of regulating pressure in a fluid regulating system substantially as described in the embodiment herein.

The Patent Office

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Application No: GB 9803942.3
Claims searched: All

Examiner: James Porter
Date of search: 14 May 1998

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

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Int Cl (Ed.6): E03B 7/00, 7/02, 7/04, 7/07; F17D 1/00, 1/04, 3/00, 3/01; G05D 16/00, 16/02, 16/08, 16/20

Other: Online database: WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
A	GB2123983 A	(DELTA)	-
A	WO95/02126 A1	(FISHERMAN)	-
X	US5047965 A	(ZLOKOVITZ) See whole document	1-4, 6, 9 & 11

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
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